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*In air combat, “the merge” occurs when opposing aircraft meet and pass each other. Then they usually “mix it up.” In a similar spirit, Air and Space Power Journal’s “Merge” articles present contending ideas. Readers can draw their own conclusions or join the intellectual battle-space. Please send comments to [aspj@maxwell.af.mil](mailto:aspj@maxwell.af.mil).*

## Network-Centric Operations

### A Need for Adaptation and Efficiency

**CDR Phillip G. Pattee, USN, Retired\***

In an article published in 1998, Vice Adm Arthur K. Cebrowski and John J. Garstka argued that “network-centric warfare and all of its associated revolutions in military affairs grow out of and draw their power from the fundamental changes in American society. These changes have been dominated by the co-evolution of economics, information technology, and business processes and organizations.” At that time, the authors noted that three themes governed the path that the military would take to change the way it conducted operations:

- The shift in focus from the platform to the network
- The shift from viewing actors as independent to viewing them as part of a continuously adapting ecosystem
- The importance of making strategic choices to adapt or even survive in such changing ecosystems.<sup>1</sup>

The Department of Defense (DOD) has made tremendous strides along the lines of the first theme by exploiting networks of high-technology weapons systems but little progress on the second theme, including—at the most basic level—understanding what it means. The third theme, a clarion call urging the military to change in order to remain competitive, should cause the national security establishment to reflect on the second theme and decide exactly what it wants to do about it. Back in early 1998, Cebrowski and Garstka asked, “How can the military not change?”<sup>2</sup> The military’s biggest obstacle to change lies in its failure to rethink its rules as an actor among others in a continuously adapting ecosystem. Currently, the DOD focuses overwhelmingly on exploiting new technologies for military advantage, but these gains “are of marginal utility against a diffuse and elusive insurgency” such as the one pursued by al-Qaeda.<sup>3</sup> Only one actor among many in the national security environment, the DOD will not realize the promise of dramatically improved national security if it continues a nearly exclusive emphasis on

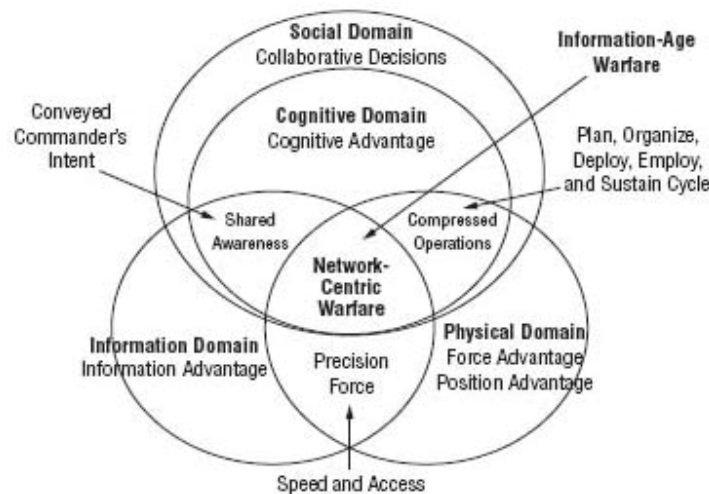
exploiting new technologies for their value within the context of traditional military operations. Ensuring its continued viability requires a balance between exploitation and exploration: exploitation in order to promote efficiency and economy, and exploration in order to investigate radically new approaches to national security.

### **Networking Is Not New**

Although the DOD has not precisely defined network-centric warfare, proponents identify “to network” as a verb, noting that the concept fundamentally concerns human behavior and the way humans behave “in the networked environment.”<sup>4</sup> When referring to the environment, “network,” as a noun, means an interconnected group or system, while “to network” denotes the act of interconnecting. Networking is not novel: humans have operated in a networked environment for millennia. The relevant point about networking involves determining which types of interconnections to encourage, permit, discourage, or restrict, as well as using new technology to foster desired networking but restrict the undesirable variety. Network-centric operations deal with shaping networks to exploit the emerging environment to one’s advantage.

### **Networking for Exploitation**

The Office of Force Transformation developed a construct for network-centric warfare as the intersection of four warfare domains: physical, informational, cognitive, and social (fig. 1). The physical domain includes the continuum of space and time. In the information domain “information is created, manipulated, and shared.” The “mind of the warfighter” makes up the cognitive domain, and in the social domain, “humans interact, exchange information, form shared awareness and understandings, and make collaborative decisions.”<sup>5</sup> In this paradigm, the information and cognitive domains intersect to form shared awareness, the cognitive and physical domains intersect to form compressed operations (planning, organizing, deploying, employing, and sustaining), and at the intersection of the information and physical domains, speed and access enable precision force. Although its proponents state that network-centric warfare “exists at the very center where all four domains intersect,” they have not ascribed any importance to the social domain as a piece in the ecosystem.<sup>6</sup> Moreover, the model itself follows a narrowly defined mission for the military, based on deterring war and—when deterrence fails—fighting and winning the nation’s wars. One finds evidence for this in the fact that the domains of *conflict* intersect to form the construct for network-centric *warfare*. The cognitive domain embodies the mind of the *war fighter*. The Office of Force Transformation’s emphasis on warfare, conflict, and war fighter shows that its conception of network-centric operations represents a strategic choice to network within a narrowly defined social domain of military professionals for the conduct of strictly military operations.



**Figure 1. Information-age warfare—domains of conflict.** (From *The Implementation of Network-Centric Warfare* [Washington, DC: Department of Defense, Office of Force Transformation, 5 January 2005], 21, [http://www.oft.osd.mil/library/library\\_files/document\\_387\\_NCW\\_Book\\_LowRes.pdf](http://www.oft.osd.mil/library/library_files/document_387_NCW_Book_LowRes.pdf).)

This type of limited networking to exploit a war-fighting advantage has already produced an excellent precision force that has repeatedly demonstrated a battlefield advantage over less-networked adversaries.<sup>7</sup> With today's technology, only adversaries beyond sensor reach feel safe. For example, during Exercise Northern Edge 2006, the F-22 Raptor air-superiority fighter prevailed against 40 simulated enemy aircraft, achieving an impressive overall kill ratio of 108 to zero. Moreover, when operating in a network, the F-22, by using its onboard sensors to direct other aircraft's weapons, improved the performance of the older F-18s and F-15s.<sup>8</sup> Networking in this manner enables the best sensors to couple with the combined payload of all aircraft, effectively spiraling performance by combining the best attributes of each platform. The DOD has made tremendous strides along the path from platform-centered operations to network-centric operations, but this progress has little bearing on the second of the themes, "the shift from viewing actors as independent to viewing them as part of a continuously adapting ecosystem," mentioned above.

No reason exists for limiting the model of network-centric warfare to conflict since the physical world, information, cognitive processes, and social constructs apply equally well to other situations. Cebrowski and Garstka cite the example of Wal-Mart's shift to point-of-sale scanners to track weekly store sales. By providing this information directly to suppliers, Wal-Mart eliminated the platform-centric purchasing department at each store, thus reducing operating costs and improving control over its stock.<sup>9</sup> Sharing information to reduce its sales cost below the industry average enabled Wal-Mart to exploit its already dominant position in the retail sector.

Nevertheless, adopting similar strategies for the military, as in the domains-of-conflict paradigm, creates a culture that needlessly limits the joint force to network with allies and others in the DOD to improve the military's ability to conduct warfare. In fact, instead of conceiving new methods of national security, network-centric warfare's central point simply entails translating an information advantage into a competitive advantage for military operations.<sup>10</sup> Continuing down this road will likely lead the military to more effective operations, but the payoff on investment

for improved national security remains uncertain. The United States armed forces have had no peer since the breakup of the Soviet Union.<sup>11</sup> America has produced the finest military in the world by following simple rules. To reiterate, the military exists and organizes itself to deter aggression against the United States and to fight and win the nation's wars when deterrence fails. If we continue to view the military's purpose as deterring and winning wars, will that guarantee national security in an evolving security environment? When Cebrowski and Garstka argued for network-centric warfare, they expected to incorporate the ideas and strategies used successfully by American businesses. One lesson from industry maintains that "dominance lies in making strategic choices appropriate to changing ecosystems" and, more to the point, that "simply pursuing operational effectiveness while adhering to an obsolete strategy is a formula for failure."<sup>12</sup>

### **Viewing the World as Complex Adaptive Systems**

The shift from viewing actors as independent to viewing them as part of a continuously adapting ecosystem involves changing the way one thinks about the world. Every actor has the capability to interact in some fashion with its environment and with other actors. Groups of actors form populations, which, especially if the members act in concert, become actors in their own right. The way actors interact with the environment, other actors, or populations in pursuit of specific goals is a strategy. A pattern of interaction is a network. Actors and populations usually are part of multiple networks. Actors, their environment, patterns of interaction, and strategies compose a system whose properties emerge from the actions and interactions of the parts. Since components of the system change (i.e., new actors are born while others die; technologies can alter strategies and change the ability of actors to interact; actors vary their strategies; etc.), the system to which they belong changes continuously as well.<sup>13</sup> Sometimes change is slow and small—sometimes fast and furious.

Negative feedback dominates relatively stable systems. Adapting systems have a mix of positive feedback based on increasing returns and negative feedback to keep them from degenerating into chaos. In this region of bounded instability, individual or collaborative creativity can produce new standards or rule sets. An initial advantage, when magnified by increasing returns, generates a successful paradigm that other actors will mimic and adopt. Once the standard becomes successful and widely adopted, those who deviate from it incur penalties—hence, negative feedback again dominates in the system and the standard becomes locked in.<sup>14</sup> This continues until new patterns emerge with new rules for success that eventually undermine the older system and replace it. Kevin Kelly, *Wired* magazine's executive director, refers to this process as sustainable disequilibrium or churn.<sup>15</sup>

The main elements that produce adaptive behaviors in these complex systems are the richness of interactions and variety.<sup>16</sup> The attractiveness of the new system to others who will voluntarily support and sustain it generates increasing returns. Various actors spontaneously self-organize around the attractors, and a new self-synchronizing system emerges from the bottom up.<sup>17</sup>

## **Networking for Exploration: Strategic Networking and Transformation**

Strategic choice in a changing ecosystem deals fundamentally with recognizing emerging patterns, determining the rules or attractors governing the new order, and posturing oneself to take advantage of the new system as it develops. As an example, consider the rise of Wal-Mart to its position of prominence in the retail sector. Prior to 1962, competition from regional discount chains was squeezing out Sam Walton's few variety stores. Obviously concerned, he "traveled the country to study this radical, new retailing concept."<sup>18</sup> Instead of determining how he could find more efficiency in a local market, Walton increased his network to the national level, looking for emerging national trends. His interaction with other retailers and potential customers enabled him to recognize an emergent pattern. Convinced that this new retailing model was the wave of the future, Walton postured his business to take advantage of evolving shopping patterns by opening the first Wal-Mart in Rogers, Arkansas, in 1962.<sup>19</sup>

Convenience paired with value made this new retailing model attractive to consumers. Walton thought about his store from the point of view of the customer, providing a "wide assortment of good quality merchandise; the lowest possible prices; guaranteed satisfaction with what you buy; friendly, knowledgeable service; convenient hours; free parking; [and] a pleasant shopping experience."<sup>20</sup> As an actor, Walton mimicked the strategy already pioneered by other retailers such as Kmart and Target to tailor the store to attract shoppers by offering value and convenience.

In addition to the way he configured his stores, Walton used aerial observation to choose their locations.<sup>21</sup> During the 1960s and 1970s, many Americans bought homes in suburbs. Using an old airplane for observation, Walton could see where suburbs were growing and where populations of customers would be in several years' time, pick out likely traffic routes, and note the areas neglected by his competitors. By locating his stores conveniently for emerging shoppers, he created more frequent interactions with potential customers and immediately capitalized on developing local markets.

Walton recognized two rising patterns: consumers' new shopping preferences and customer locations/traffic routes. He dismissed the strategy of simply trying to make the best of his situation by improving the operating effectiveness of his Walton's Variety Stores—the emerging pattern signaled their demise, irrespective of their efficiency. Instead, Walton developed a strategy that created opportunity to interact with more customers and provide them with an attractive store by offering convenience and value. He did this by having a social domain much larger than that of the local economy and other variety-store retailers. The emergent system of customers, interactions, and attractors transformed Sam Walton's business and locked in Wal-Mart as a retail success.

A second example of revolutionary change comes from a depression-era truck driver from North Carolina named Malcolm McLean. After World War II, the demand for trade and cargo continued to increase. The initial solution to the problem called for building larger freighters. In

1955 McLean acquired the Pan-American Steamship Company with the proceeds gained from the sale of his trucking firm and began to experiment with ideas to increase the throughput of cargo. His innovation took the form of using containers that could be unloaded from truck trailers and loaded onto ships. Despite initially slow progress, in 1961 the International Standards Committee established containers measuring 20 x 8 x 8.5 ft. and 40 x 8 x 8.5 ft. as the standard.<sup>22</sup> Ships were constructed with rails in their holds to accommodate the containers. By 1967 McLean's Sea-Land Corporation had won a contract with the US government to transport much of what the Army needed to sustain itself in Vietnam. In addition to shipping from seaport to seaport, Sea-Land assumed responsibility for moving freight to inland depots. The intermodal containers moved easily from ship to railcar or truck bed and vice versa so that Sea-Land could "track shipments, retain oversight of the containers, and ensure that the empty boxes were returned for further use."<sup>23</sup>

At this point, the commercial sector realized the system's advantages and began to place orders for ships built to accommodate containers. Today, oceanborne commerce amounts to 1,167.9 million metric tons, nearly double the amount 20 years earlier. Prior to the container revolution, "a typical freighter could handle only 10,000 tons" and took upwards of two weeks to unload and load cargo. Today, each 20-foot container can hold up to 20 tons of cargo, and a port such as Long Beach, California, can handle over 23,000 containers daily—roughly the equivalent of unloading and loading 45 freighters a day.<sup>24</sup>

Cargo hauling has locked in around the container standard with ships, trucks, railcars, cranes, and port facilities all constructed as a network to support the seamless movement of goods. Deviating from the standard will incur increased time and cost for the shipper. McLean could have endeavored simply to improve the efficiency of trucking by exploiting larger trailers and more fuel-efficient tractors, but that strategy would not have produced the exponential growth in trade that he eventually achieved by creating new standards that the entire sector adopted.

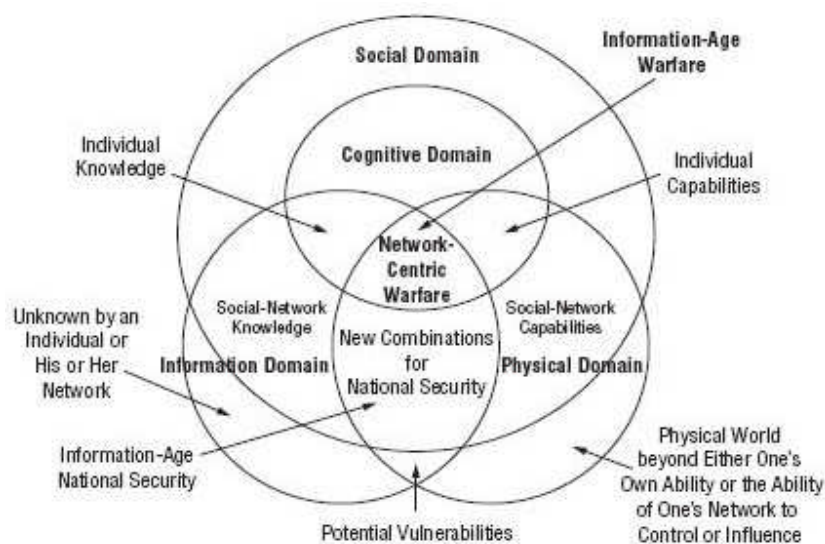
Networking for exploitation has its place. Wal-Mart has shifted from utilizing purchasing departments in its stores to computer networks that provide suppliers with real-time sales data of the products they produce. Suppliers use this data to appropriately gear their production lines to meet demand.<sup>25</sup> This kind of networking makes Wal-Mart more efficient. However, networking in a strategic sense to explore new concepts in a large and diverse social domain (fig. 2) seeks new combinations of emerging patterns and rule sets to produce novel solutions to enduring problems. This exploratory networking enabled Sam Walton to take advantage of emerging patterns, ultimately transforming his variety stores into a completely different type of retailer. This is why Wal-Mart has become a giant in the retail sector. Similarly, McLean sought better ways to move cargo beyond exploiting what was available in the trucking industry. By creating a network involving shipbuilders, port authorities, governmental departments, and the International Standards Committee, McLean transformed the entire shipping industry.

## **Recommendations**

Using networks to interact with diverse groups to generate a variety of collaborative ideas that, in turn, will produce new methods for achieving national security is at least as important for the DOD as using networks to gain military advantage. Carl von Clausewitz concluded long ago that

war was part of a pattern of politics. Alfred Thayer Mahan also postulated that economic competitions often led to military competition. The links among political, economic, and military systems exist and create their own more complex system. The DOD will not see patterns or be in a position to capitalize on them if it views itself as independent; that department must think of itself as an actor constituting part of a larger, continuously adapting ecosystem. Thinking about the world in this way, as complex adaptive systems, comes from the modern science of complexity. As the key first step toward understanding complex adaptive systems, the DOD should incorporate complexity theory into all levels of professional military education.

The second essential step calls for DOD personnel to deliberately choose to network broadly. Familiarity gained in previous professional education will enable this initiative. Service members would understand that the purpose of networking is to define patterns and rule sets in use by other actors. It is unreasonable to expect any individual to master the broad range of disciplines that actually make up the international political and economic system. That is why policy makers and planners must have large social networks; what they cannot know, their network can (see fig. 2). By networking in political, economic, business, scientific, religious, and social systems, DOD policy makers and planners have a stronger chance of recognizing emerging patterns and appropriately posturing government departments to take advantage of them. Military leaders should encourage service members to pursue broad interaction within their neighborhoods and cities and with other government agencies as well as the private-business sector to develop diverse interests, a variety of expertise, and numerous personal contacts as a matter of course in career development. Broad, diverse networks represent a key source of the variety that leads to true innovation and breakthrough. The goal of networking this broadly, as shown in figure 2, involves moving from network-centric warfare toward networked national security.



**Figure 2. Information-age security.** (Adapted from The Implementation of Network-Centric Warfare [Washington, DC: Department of Defense, Office of Force Transformation, 5 January 2005], 21, [http://www.oft.osd.mil/library/library\\_files/document\\_387\\_NCW\\_Book\\_LowRes.pdf](http://www.oft.osd.mil/library/library_files/document_387_NCW_Book_LowRes.pdf).)

Finally, the DOD needs to adopt various new strategies on a trial basis with the idea of modifying them to suit emerging circumstances. The past tendency has involved running long series of experiments prior to implementing new doctrines, equipment, or strategies. Real and potential enemies, however, are already working to undermine rules and paradigms that do not suit them. Terror networks use their knowledge of social networks and information-age technology to avoid engaging strong Western-style militaries in traditional symmetrical warfare. Thus, terror networks have already mitigated some of the advantages that new systems such as the F-22 Raptor create. The point is that prolonged experimentation may simply perfect a solution to yesterday's problem and remain only marginally effective against the problems currently emerging. The context for which a new system or strategy is designed is neither fixed nor linear—it constantly changes. While terrorists successfully expand their networks, US policy makers and planners remain stagnant; consequently, potential vulnerabilities develop and grow. The DOD must not only strenuously investigate technological solutions to problems but also examine social and political structures to understand them and find nontechnical ways to manage and enhance national security.

## Conclusion

The DOD has mastered traditional military conflicts and is gaining efficiencies with its current networking initiative. However, it still lacks proficiency in the larger social domain that will lead to new combinations for enhanced security. We must educate military officers to think in terms of new combinations—the journey starts in the officer-education system. Adaptation will come much faster and more regularly with constant exposure to new ideas and perspectives. Variety in ideas and perspective emerges from a large social network. The DOD must expand its networking effort to guard against becoming a highly efficient but irrelevant force for national security.

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## Notes

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